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CIRCADIAN HEART RATE RHYTHMICITY: COMPARISON BETWEEN AN ESKIMO AND OTHER POPULATION GROUPS

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We have previously described circadian rhythms of heart rates in an isolated population of Aymara indians living in the Bolivian altiplano⁴. This second report focuses attention on another isolated population, Eskimos living in the relatively flat and treeless arctic tundra region of St. Lawrence Island in the Bering Strait situated at 63 °N.

One previous work reports the absence of heart rate rhythms in Eskimos³ although no specific data are given. A strong circannual rhythm was noted, however, with peaks in the fall. Eight subjects were tested 8 times a day; lifestyles were not described. Work has been done on the circadian rhythms of selected urinary variables. These studies⁸ failed to find rhythms in Eskimos living without electricity, which appear in Eskimos living in heated homes with electric lighting. The characteristics of the circadian rhythms in the latter instance seemed under seasonal influence.

We intend to determine here whether circadian rhythmicity exists in a population of Eskimos living in the far north that has the social synchronizers made available through electric power. We compare the rhythmicity parameters for this population to those previously obtained in another developing society under different environmental conditions and to western populations.

Key-words: Circadian rhythm; Eskimo; Heart rate.

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SUBJECTS, MATERIALS AND METHODS

The sample of 24 individuals (3 females, 21 males) ranged in age from 18 to 69 at the time of the study. They were residents of either Savoonga or Gambell, two small (< 400 inhabitants) towns situated on St. Lawrence Island in the Bering Strait. They are representative by occupation of the individuals living in these villages. Their selection was based on willingness to participate. Cardiac health was evaluated by the field cardiologist (F.A.). In addition, resting 12-lead electrocardiograms and blood pressures were recorded. The study was completed within the month of March 1979, to minimize any seasonal effects. The subjects had electricity, thus lighting in their homes, and heating and therefore were able to control their synchronization.

The recordings were made on magnetic tape cassettes using a 24-h portable recorder (MEDILOG, Model 4-24, Ambulatory Monitoring Instruments, Ardsley, N.Y.). Tapes were degaussed prior to their use and protected from possible magnetic fields afterwards. The MEDILOG is of negligible size (4 3/8 x 3 1/2 x 1 3/8 inches). The cassettes were analyzed on an American Optical Model 6002-Dyna Gram Scanner, which records number of beats/minute, as well as number of beats/hour¹.

The data were analyzed using the group mean cosinor method^{6,12}. The reference for acrophase was midnight⁶.

RESULTS AND DISCUSSION

A significant rhythm ($p < 0.005$) was detected for our sample with $M = 79.72 \pm 0.53$ beats/min, $A = 8.78$ (7.03–10.53) beats/min and $\phi = 15^{35}$ ($14^{47} - 16^{22}$) (h^{min}) with 95% CL within parentheses. In Tab. 1 we present not only our current findings but those we have previously reported on a population of Aymara indians living in the Bolivian altiplano. In addition, two studies involving developed societies are given for comparison. All the populations were mixed, males and females. The French and Americans were younger, however.

It is important to bear in mind the differences that characterize these diverse populations. First, the Eskimos live in a cold, harsh environment that goes from annual periods of near total darkness to near total light. The altiplano Indians also live under harsh circumstances with huge day-night differences in temperatures, strong winds and low oxygen pressure (they live at altitudes of 4,000 m) but the hours of daylight vary little in the course of the year. Secondly, they differ in

population place	no.	mesor M ± SD	amplitude (A) beats/min	acrophase ϕ h min	rhythm- detection P	researcher
			(95% CL)			
Eskimos, Alaska	24	79.72 ± 0.53	8.78 (7.03–10.53)	15 ³⁵ (14 ⁴⁷ –16 ²²)	0.005	present study
Aymara Indians, Bolivia	13	64.19 ± 2.03	12.07 (5.47–18.78)	14 ⁵⁴ (12 ³⁸ –16 ⁴⁸)	0.005	CLENCH et al. ⁴
French	7	75.2 ± 8.47	7.70 (4.50–10.9)	15 ⁵⁶ (13 ⁴⁸ –17 ⁴⁰)	0.002	REINBERG et al. ¹³
American	9	67.6 ± 5.7	6.57 (3.82– 9.31)	18 ²⁷ (16 ²⁹ –20 ⁵²)	0.001	BETHEA ²

Tab. 1 - Circadian rhythm parameters of heart rates in different primitive and non-primitive societies, living under different environmental conditions.

synchronization. The Aymara have electricity provided by a generator only a few hours each night and are synchronized by actual day length. The Eskimos have electricity and heating but lead socially unrestrictive lives. They can and do sleep at will. The Western world not only has electricity but lives highly regimented lives with strict waking and working hours. During the time of the studies, the Aymara were experiencing 15 h of light and 9 of darkness whereas the Eskimos had a roughly LD 12:12. The measurements were made during the Bolivian fall and Alaskan spring. Thirdly, they differ culturally. These differences include levels of activity and nutritional intake. The Aymara have to walk everywhere, whereas the Eskimos ride snowmobiles. The Aymara do not have to hunt, but the Eskimos do. Fourthly, they differ in body build. The Aymara and the Eskimo physically and genetically more closely resemble one another than they resemble Caucasians^{5,10}. Finally, three totally different racial groups are represented, namely: Eskimo, Indian and Caucasian.

Given these possible reasons for differences, the similarity between the populations is impressive. The same basic rhythmicity of heart rate exists in all 3 populations; the acrophases (or time to peak) are nearly identical. The Aymara retain their unusually high amplitude (for males and females, having a wide range of ages). It is only the mesor or 24-h rhythm adjusted mean that shows unusual differences. Both the Alaskan and Bolivian data were collected using the same equipment and by the same person (S.A.B.). The Δt between measurements was 60 min in the Bolivian study and 15 min in the Alaskan study which should only influence the degree of variability. Thus, the studies are comparable as to methodology. Nonetheless, the 24-h means differ by about 15 beats/min in the two populations. The Western populations are situated between these two, less economically developed cultures.

In our earlier paper we suggested that the low mesor and high amplitude of the Aymara might represent a superior fitness or adaptation to cold⁴. The present study suggests that adaptation to cold is unlikely. Eskimos are considered to be in good physical shape as indicated by maximum O_2 intake, vital capacity, cardiac output, etc.^{16,17}. For a variety of reasons, these include the vigorous physical demands of hunting and carrying children on the back, evolutionary pressures of episodic starvation and disease, high protein diet and cultural isolation, a high mesor in the Eskimo would seem to rule out physical fitness as a causal agent of the Aymara's lower mesor. But the Aymara were measured during their season of activity whereas the Eskimos were still waiting for the ice to thaw to begin hunting and were relatively inactive. The Aymara sleep in unheated homes whereas the Eskimo do not.

Are the differences we have observed due, at least in part, to low oxygen pressure? A low heart rate in Andean indigenes has previously been reported^{9,11,14,15}. This does not, however, explain the much higher values in the Eskimo. High heart rate or sinus tachycardia has not to our knowledge previously been reported among Eskimos. Are the differences racial? LEBLANC⁷ reports, in comparing cold adaptation in whites relative to Eskimos, that hand immersion did not produce a rise in heart rate in Eskimos whereas it rose 10 beats/min in whites. Face immersion produced a drop in both groups, a drop that was twice as sharp in the whites. Control values were the same for both groups.

The pulse exhibits intrinsic rhythmicity under a variety of environmental, cultural, and ethnic conditions. Although we demonstrate the basic rhythmicity of heart rate under diverse environmental conditions as to time of peak and amplitude, this paper demonstrates a variability in mesor that originates either from ethnicity, the environment, or a combination of both.

SUMMARY

This brief communication reports the result of 24-h ambulatory cardiac monitoring of a Bering Strait Eskimo population and compares the findings with 3 other populations. Similar heart rate rhythmicity and almost identical acrophases are found in the Eskimo, Aymara Indian and French populations. However, the Alaskan Eskimo and Aymara Indian 24-h means vary by approximately 15 beats/min, with the American population between these two. The mesor displays the most radical differences.

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